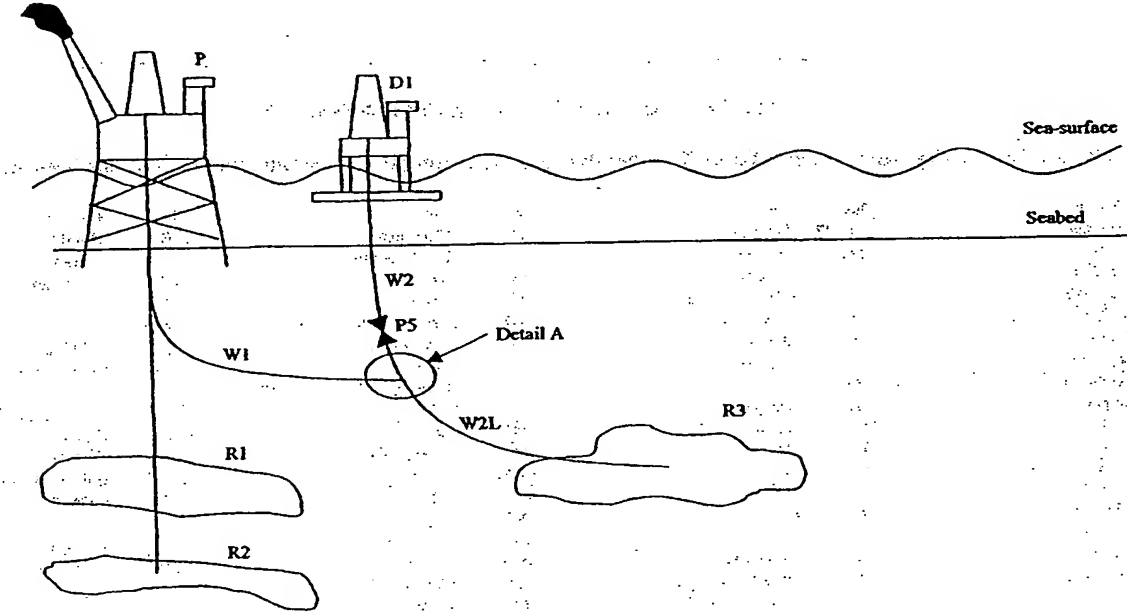


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<p>(21) International Application Number: PCT/GB99/01593 (22) International Filing Date: 19 May 1999 (19.05.99) (30) Priority Data: 9810722.0 20 May 1998 (20.05.98) GB (71)(72) Applicant and Inventor: JOHNSTON, Sidney, Dantuma [GB/GB]; 23 Duthie Terrace, Mannofield, Aberdeen AB10 7PP (GB). (74) Agent: MURGITROYD &amp; COMPANY; 373 Scotland Street, Glasgow G5 8QT (GB).</p>		<p>(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).</p> <p><b>Published</b> <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i></p>
<p>(54) Title: METHOD OF PRODUCING FLUIDS FROM AN UNDERGROUND RESERVOIR</p>  <p>(57) Abstract</p> <p>A method is disclosed for producing fluids such as oil and gas from a wellbore, typically a subsea wellbore. The method comprises linking first and second wellbores to enable reservoir fluids located in a reservoir into which the second wellbore passes to reach both wellbores in order to avoid the need for surface pipelines linking the two wells.</p>		

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1     METHOD OF PRODUCING FLUIDS FROM AN UNDERGROUND RESERVOIR

2  
3     The present invention relates to a method of producing  
4     fluids from underground reservoirs, and particularly  
5     relates to using first and second wellbores to link  
6     such reservoirs to a production facility.

7  
8     Hydrocarbon reservoirs of oil and gas which are located  
9     too far from existing or proposed hydrocarbon  
10    production facilities are typically developed by  
11    drilling wells from directly above those reservoirs,  
12    and then providing a pipeline from the wellhead to the  
13    production facility.

14  
15    According to the invention there is provided a method  
16    of producing fluids from underground reservoirs, the  
17    method comprising drilling a first wellbore, drilling a  
18    second wellbore into the reservoir, and linking the two  
19    wellbores to allow fluids to flow from the reservoir to  
20    the first wellbore.

21  
22    Preferably the reservoir is an oil or gas well  
23    reservoir, and most preferably an offshore reservoir.

24  
25    The first wellbore is typically at least partially

1 deviated, so that it extends from a site of a  
2 production platform (or similar facility) laterally  
3 towards the reservoir for the maximum distance feasible  
4 for horizontal or lateral drilling.

5  
6 The second wellbore can optionally be drilled  
7 subsequently so as to pass through (or close to) the  
8 end of the first wellbore and can be vertical or  
9 deviated as required to connect the reservoir to the  
10 first wellbore.

11  
12 The first and second wellbores can be linked by a  
13 number of means. For example, the second wellbore can  
14 simply pass through the first wellbore, and can be  
15 plugged between the junction with the first wellbore  
16 and the surface, so that fluids passing through the  
17 second wellbore from the reservoir are diverted only  
18 into the first wellbore. Alternatively, the first and  
19 second wellbores can be linked by a further wellbore  
20 drilled before or after the second wellbore, or a  
21 series of such further bores, so that the fluids can  
22 travel from the reservoir to the first bore through a  
23 series of interconnected bores. The first and second  
24 (and/or the further) bores can be drilled so as to be  
25 separated from one another by a portion of the medium  
26 through which they are drilled (ie they can pass close  
27 to the ends of the previous bore but not connected  
28 thereto to allow fluid flow) and can be linked  
29 subsequently by controlled explosion at the ends of the  
30 bores, by perforation by some other means, by  
31 fracturing, by stimulation, or by drilling etc.  
32 Indeed, in one embodiment of the invention it is an  
33 option to generate an explosion at the end of the first  
34 (or subsequent further) bore in order to create a  
35 chamber of a size large enough to facilitate drilling  
36 into the chamber when the subsequent wellbore is

1 drilled. Alternatively, where the formation permits,  
2 first or subsequent further wellbores can be drilled  
3 deliberately into naturally occurring voids (ie  
4 formations capable of permitting fluid flow through  
5 such formations), so as to allow easy interconnection  
6 of the chain of wellbores.

7  
8 One advantage of the invention is that pipelines  
9 necessary to connect remote wellheads to production  
10 facilities can be avoided and this avoids expense in  
11 constructing, maintaining, operating and inspecting the  
12 pipeline and associated injection pipelines and control  
13 umbilicals etc. In addition to cost benefits, the  
14 invention allows a decrease in the hydrocarbon-bearing  
15 installations above land or above the seabed, thereby  
16 reducing potential environmental and safety impacts.

17  
18 This invention is therefore particularly applicable in  
19 environmentally sensitive areas such as Alaska.

20  
21 An embodiment of the present invention will now be  
22 described with reference to the accompanying drawings  
23 in which:-

24  
25 Fig.1 is a schematic representation of a system of  
26 wells drilled according to the present invention;

27 and

28 Fig. 2 is a schematic representation of a system  
29 of wells drilled according to a second embodiment.

30  
31 Referring now to the drawings, Fig. 1 shows a fixed  
32 drilling/production platform P having a vertical well  
33 connecting the platform to two hydrocarbon reservoirs  
34 R1, R2 directly below the platform P. The platform P  
35 is also drilling, by conventional, known means, a  
36 laterally deviated well W1 in the direction of a third

1 hydrocarbon reservoir R3 laterally displaced from the  
2 production platform P. When the limit of horizontal  
3 drilling of well W1 is reached, a second well W2 is  
4 drilled from a semi-submersible (or fixed jacket or any  
5 other drilling facility) drilling platform D1 downwards  
6 from the platform D1 in the direction of the end point  
7 of well W1. W2 can be drilled straight through a  
8 portion of W1, for example at the end thereof, or can  
9 be drilled so as to pass close to the end of W1, but  
10 not to intersect with it to allow fluid flow between W2  
11 and W1. In the embodiment shown in Fig. 1, the well W2  
12 has been drilled to intersect with W1 and allow fluid  
13 transfer between the wellbores.

14  
15 After intersecting or passing close to W1, the second  
16 well W2 is drilled laterally as W2L towards the third  
17 hydrocarbon reservoir R3. When W2L reaches the  
18 formation of hydrocarbon reservoir R3, the drilling  
19 string extracted and the wells completed, a plug P5 can  
20 be inserted in W2 between the junction with W1 and the  
21 platform D1 so as to divert fluids flowing from  
22 reservoir R3 into W1 and therefore to the production  
23 platform P. The platform D1 is then no longer  
24 required.

25  
26 The junction between W2 and W1 (Detail A) can be made  
27 during drilling by accurately drilling W2 into W1 using  
28 directional drilling techniques. W2 can be drilled  
29 subsequently to W1, or vice versa. Alternatively, W1  
30 can be drilled into an existing and depleted  
31 hydrocarbon reservoir or other naturally occurring void  
32 from a lateral side thereof, and W2 can subsequently be  
33 drilled into the same depleted reservoir and on through  
34 it into reservoir R3. As a further alternative, the  
35 two wells can be drilled so as not to intersect but to  
36 pass within a short distance (eg a few metres) of one

1 another allowing perforation of the separation by eg  
2 explosives etc. at a later date when drilling has been  
3 completed. It can be seen from this embodiment that  
4 the order of drilling W1 and W2 does not matter.

5

6 Fig. 2 shows a further embodiment of the invention  
7 similar to that shown in Fig. 1 except that W2L is  
8 drilled into a natural occurring cavity (Detail B) at  
9 the limit of horizontal drilling of W2L. A third well  
10 W3 is drilled (before or after W1 and W2) to intersect  
11 with cavity (Detail B) and to extend thereto to  
12 Reservoir R4. As in the first embodiment, a plug P5  
13 can be installed upon completion of W3 to divert fluids  
14 from R4 into W2L and from there into W1. As before,  
15 the manner and timing of linkage from W3 to W2L is a  
16 matter of choice, and can be by eg explosives etc.

17

18 According to the invention, any number of wells can be  
19 linked together in order to tie distant reservoirs to  
20 existing or proposed platforms by boreholes rather than  
21 by pipelines. The same drill ship or platform D1 can  
22 be used to drill the second and further wells linking  
23 the first wellbore to the reservoir, and more than one  
24 wellbore can be drilled from any one drill ship so as  
25 to allow several branches leading back to the same  
26 first or subsequent lateral well, as shown in the  
27 dotted lines of wells W5 and W6 connecting reservoirs  
28 R5 and R6 respectively to the cavity at Detail B.  
29 Although described with specific examples relating to  
30 offshore drilling facilities, the invention is also  
31 applicable to onshore wells, and the drill  
32 ships/offshore platforms described in the examples can  
33 be replaced by onshore equivalents well known in the  
34 art.

35

36 The wellbore sizes can be varied according to

1 production requirements.

2

3 Should pigging facilities, chemical injection  
4 facilities etc be required then the design of the  
5 wellbores can be altered to facilitate the  
6 incorporation of such facilities eg subsurface pigging  
7 facilities from W2 to W1 and to platform P.

8

9 Modifications and improvements can be incorporated  
10 without departing from the scope of the invention. For  
11 example, although described with regard to hydrocarbon  
12 reservoirs of oil and/or gas, the invention is  
13 applicable to water and gas injection wells, and to  
14 wells for the production and recovery of other liquids  
15 gases, or slurries.

16



## 1 Claims

2

3 1 A method of producing fluids from an underground  
4 reservoir, the method comprising drilling a first  
5 wellbore, drilling a second wellbore into the  
6 reservoir, and linking the two wellbores to allow  
7 fluids to flow from the reservoir to the first  
8 wellbore.

9

10 2 A method as claimed in claim 1, wherein the first  
11 wellbore is deviated.

12

13 3 A method as claimed in claim 1 or claim 2, wherein  
14 the wellbores are linked by drilling.

15

16 4 A method as claimed in any preceding claim,  
17 wherein the reservoir is of oil or gas.

18

19 5 A method as claimed in any preceding claim,  
20 wherein the wellbores are offshore or onshore  
21 wellbores.

22

23 6 A method as claimed in any preceding claim,  
24 wherein the first wellbore extends from a site of a  
25 production platform towards the reservoir for the  
26 maximum distance feasible for lateral drilling.

27

28 7 A method as claimed in any preceding claim,  
29 wherein the second wellbore is drilled after the first  
30 wellbore.

31

32 8 A method as claimed in any preceding claim,  
33 wherein the second wellbore passes through or close to  
34 the end of the first wellbore.

35

36 9 A method as claimed in any preceding claim,

1 wherein the second wellbore is deviated.

2

3 10 A method as claimed in any preceding claim,  
4 wherein the second wellbore passes through or close to  
5 the first wellbore.

6

7 11 A method as claimed in any one of claims 1-9,  
8 wherein the first and second bores are drilled so as to  
9 be separated from one another by a portion of the  
10 medium through which they are drilled and are linked  
11 subsequently by removal of the separating portion.

12

13 12 A method as claimed in claim 11, wherein the  
14 separating portion is removed by perforation,  
15 explosion, fracturing, stimulation or by drilling.

16

17 13 A method as claimed in any preceding claim,  
18 wherein an explosion is detonated at the end of a bore  
19 in order to create a chamber into which the successive  
20 bore can be drilled.

21

22 14 A method as claimed in any preceding claim,  
23 wherein a bore is drilled into naturally occurring  
24 voids in the medium, into which a successive bore is  
25 drilled.

26

27 15 A method as claimed in any preceding claim,  
28 wherein after the two bores are linked the second  
29 wellbore is plugged between the junction with the first  
30 wellbore and the surface so that fluids passing through  
31 the second wellbore from the reservoir are diverted  
32 into the first wellbore.

33

34 16 A method as claimed in any preceding claim,  
35 wherein the first and second wellbores are linked by  
36 one or more further wellbore(s) drilled before or after

1 the second wellbore.

2

3 17 A method as claimed in claim 16, wherein the  
4 reservoir(s) is linked to a production platform by  
5 means of a linked chain of connected wellbores.

6

1 / 2

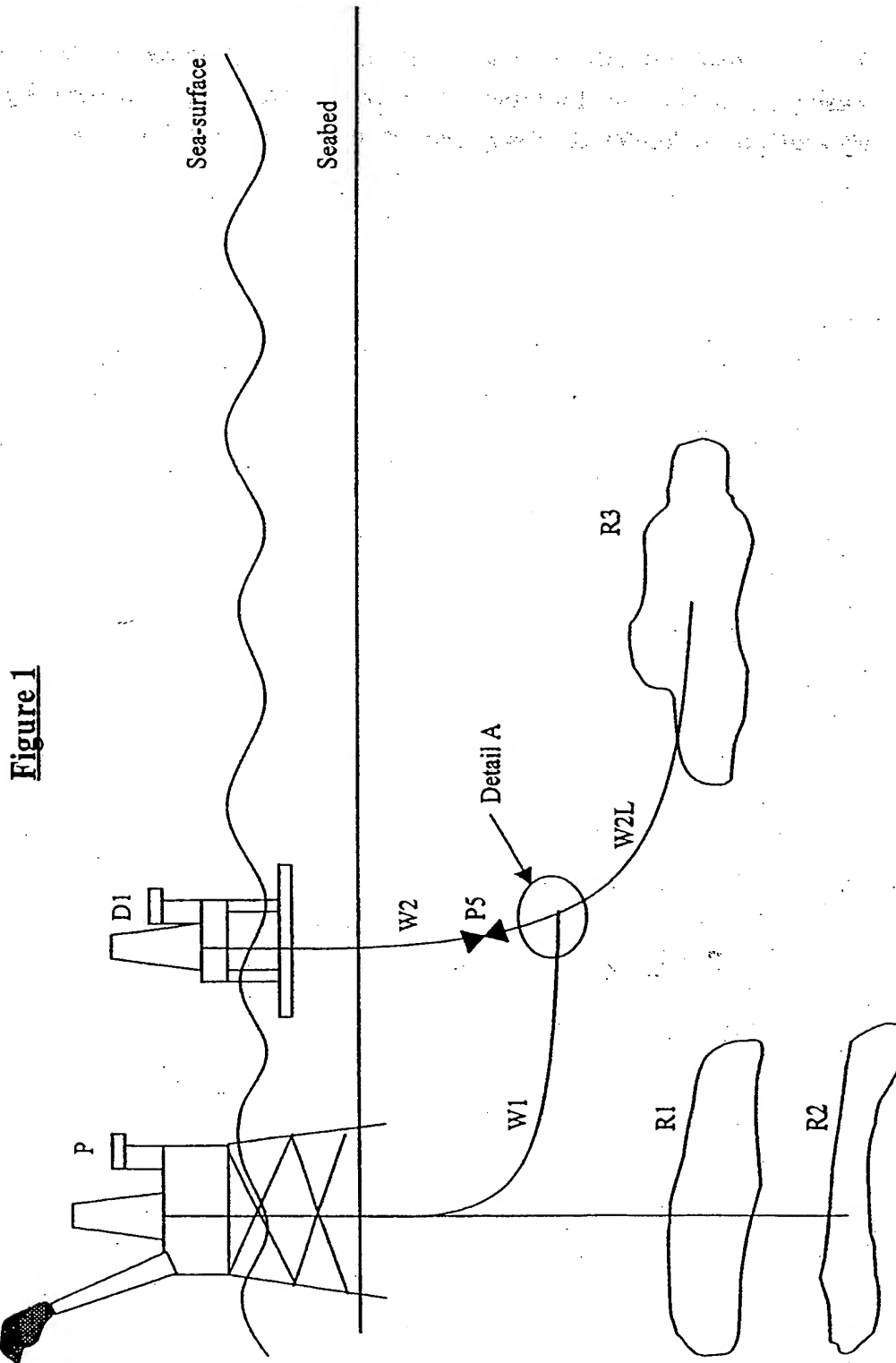
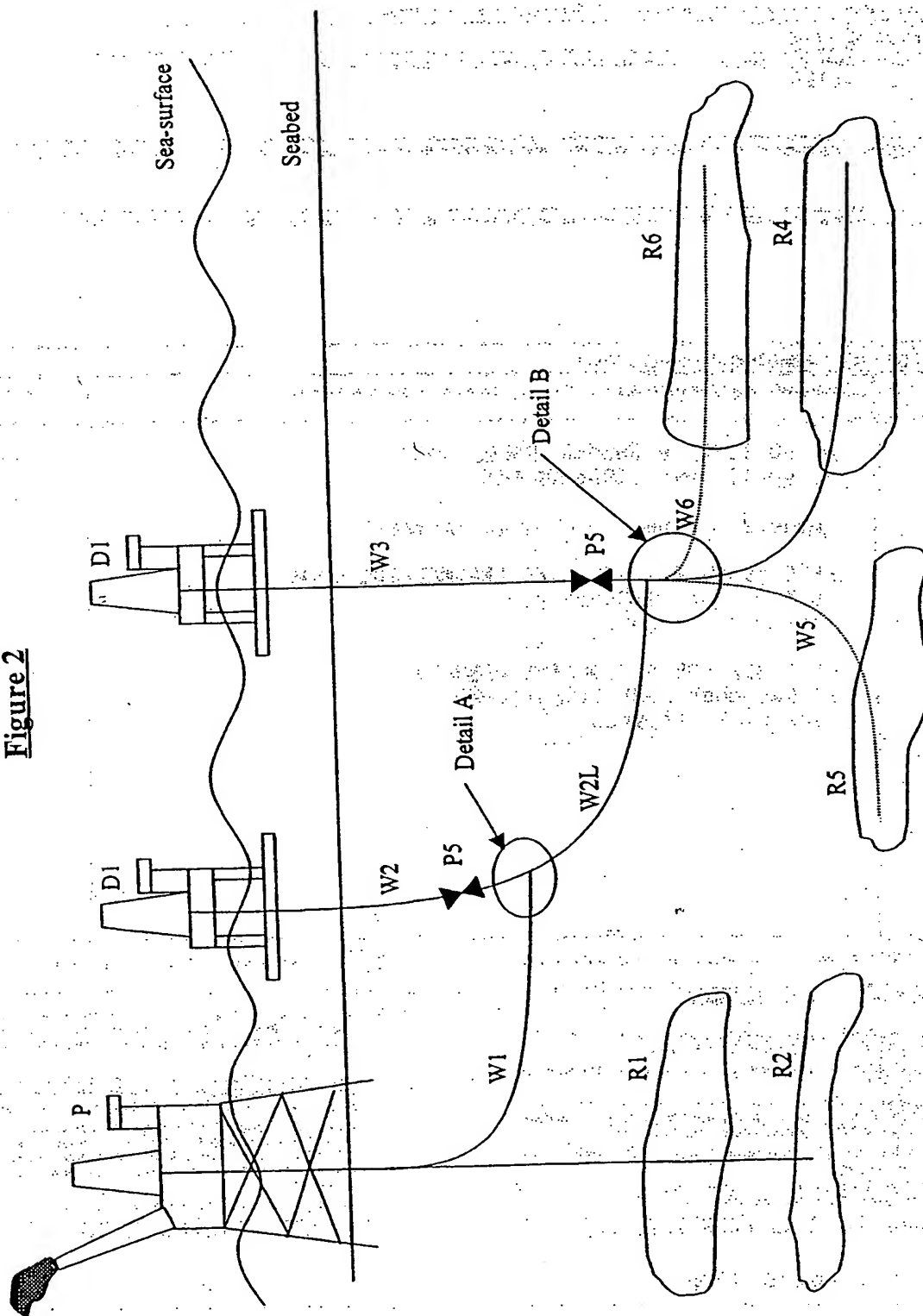


Figure 2



# INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 99/01593

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 6 E21B43/30

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 98 15712 A (BAKER HUGHES INC) 16 April 1998 (1998-04-16) page 27, line 5 - line 9; figure 5	1-5, 8-12, 15, 16
A	EP 0 598 316 A (IEG IND ENGINEERING GMBH) 25 May 1994 (1994-05-25) abstract; figures	1
X	US 4 422 505 A (COLLINS KENNETH L) 27 December 1983 (1983-12-27) abstract; figures	1

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

8 September 1999

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16/09/1999

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 99/01593

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO 9815712	A	16-04-1998	AU 4819797 A	05-05-1998
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			US 5468097 A	21-11-1995
US 4422505	A	27-12-1983	NONE	

Form PCT/ISA/210 (patent family annex) (July 1992)

*Journal of Management Inquiry* 16(4)

Figure 1. The effect of the concentration of the *Agrobacterium* suspension on the transformation efficiency of *Agrobacterium* strains.

[illegible][illegible]

1. *Phragmites australis* (Cav.) Trin. ex Steud.

100

10

[illegible]

*Journal of Management Studies*, 20(6), 791-806.

Figure 1. The effect of the concentration of the *Agrobacterium* suspension on the transformation efficiency of *Agrobacterium* strains.

10

*Journal of Management Education* 30(6)

1. *Pharmaceutical industry*

Figure 1. Schematic diagram of the experimental setup.

1000

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100

• • • • •

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[illegible]

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